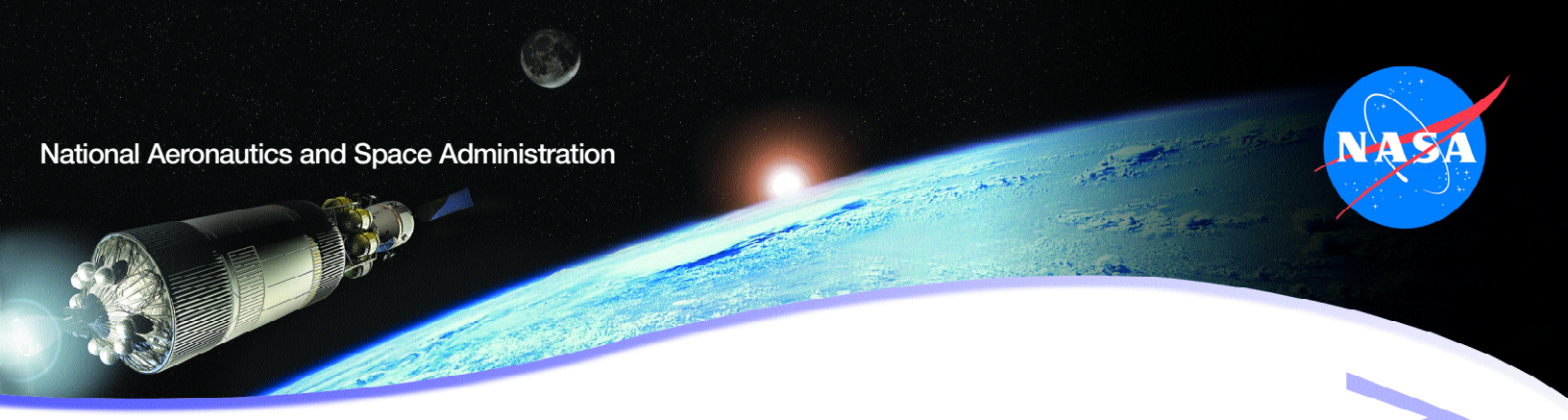


Core Flight Software System

Reducing Flight Software Development Costs

goddard technology

About the Technology

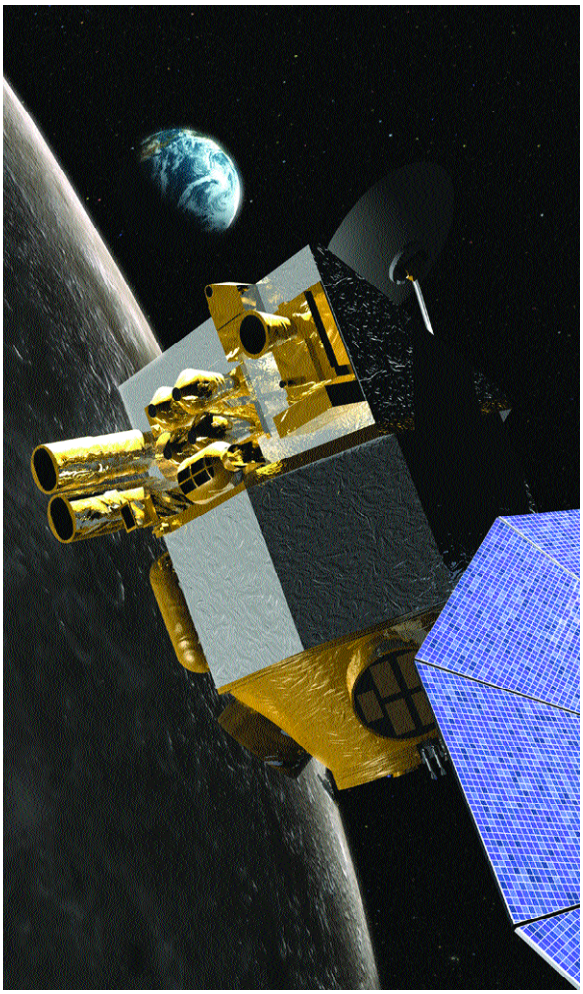
The Core Flight Software System (CFS) has reduced the costly and time-consuming process of developing software for spaceflight missions. Its flexible open architecture features a plug-and-play software executive called the Core Flight Executive (cFE), a re-use library of commonly used software components, and an integrated tool suite. Together, these pieces create a development environment where system integrators can rapidly assemble a significant portion of a software system for new missions, test platforms, and technology prototypes, resulting in reduced technical, schedule, and cost risks.

The Constellation Program's Lunar Reconnaissance Orbiter, which launched in June 2009, certified cFE for flight. Several upcoming missions, including the Global Precipitation Measurement Mission, Magnetospheric Multiscale Mission, Radiation Belt Storm Probe, and Lunar Atmosphere and Dust Environment Explorer, also have selected the technology. All are experiencing the benefits of their choice. Each mission will add to the catalog of components, which in turn will benefit future missions.

Significance of the Technology

No flight missions are alike, and in past, neither was the software needed to operate them. Flight software engineers would create custom code, spending valuable time and resources designing and testing software to make sure the products met mission requirements. But by creating an open system, software engineers can rapidly peruse a catalog and select the components they want for their mission.

The obvious benefit is that missions do not have to dedicate valuable resources to developing commonly reused software. Instead, they can use their resources to develop greater functionality onboard their spacecraft or keep down costs. In addition, development systems can be up and running in just a few weeks, not months, as was the case before. In short, CFS reduces time to flight and the risks, and allows future missions to choose from an ever-expanding catalog of reusable software components.



The Lunar Reconnaissance Orbiter is the first mission to certify the use of Goddard's Core Flight Software system.

Benefits of the Technology: At-A-Glance

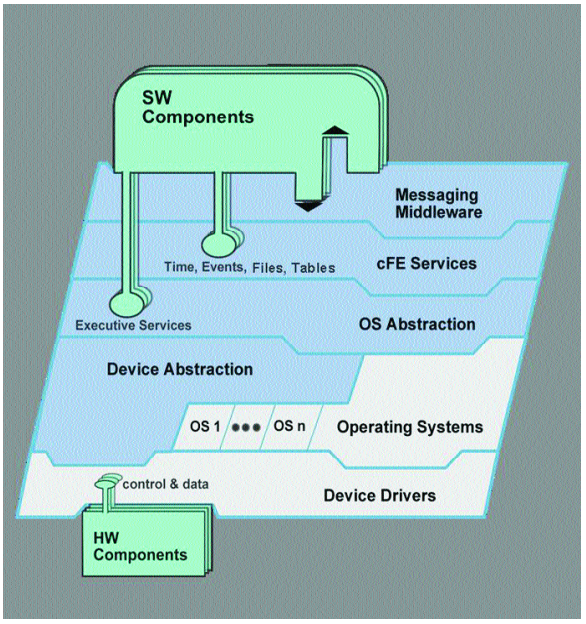
- Allows missions to focus on mission-unique applications.
- Scientists can use CFS to prototype and improve their concepts early, resulting in reduced technical, schedule, and cost risks.
- Supports real-time swapping of software and box- level hardware because of its plug-and-play architecture, which eases integration, technology infusion over time, and maintenance.
- Adds mission capability because flight software tasks are available through the CFS re-use library. Therefore, a team can add functionality even if it does not have time or the budget to create its own.
- Speeds development because catalog components are re used rather than coded from scratch. Consequently, systems can be running within weeks, rather than months.
- Lowers flight software costs and risks. All software products come from the re- use library and have been tested and documented.
- Includes a library of components that are configuration-managed with software artifacts, designs, requirements, code, unit tests, functional tests, command and telemetry databases, and operator guides.

Origins

In the past, software portability and adaptability across hardware platforms and operating systems were minimal at best. Standard interfaces across applications were almost non-existent. To reduce flight software costs, Goddard's Flight Software Branch realized that it needed to address these issues. Work began on the CFS in 2005 and involved an extensive analysis of previously used flight mission software. Many of the same senior engineers who worked on those missions assisted with these analyses. The end result is an architecture that can evolve and is flexible.

Looking Ahead

As new avionics or operating systems become available, the layered cFE can be adapted and the CFS components can be reused without any software changes. It is expected that the CFS catalog will expand with each mission, providing many more choices to mission designers who are looking to optimize schedule, performance, and cost.



The schematic shows the layered services for plug-and-play components.

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